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DRI/McGraw-Hill

34th ANNUAL DRI/McGRAW-HILL SURVEY OF RESEARCH AND DEVELOPMENT EXPENDITURES, 1989-91

July 1989

Despite the continuing cries of "lost competitiveness," U.S. corporations show little inclination to beef up their spending on research and development. According to the latest DRI/McGraw-Hill Survey, nominal R&D investment by U.S. business is projected to rise just 5.5%, to $106.4 billion, this year and a far weaker 5.1% in 1990-91 (Table 1). With inflation running at its fastest clip since 1982, the real spending rise should be less than 1%. As a result, 1989 will mark the third time in four years that real R&D spending growth has lagged real GNP growth.

These are the key findings of the 34th Annual DRI/McGraw-Hill Survey of Research and Development Expenditures. Conducted from April through June, the survey drew responses from 341 companies replying to a broader questionnaire of capital spending plans. All dollar figures in this report have been adjusted to represent R&D spending by all U.S. companies and reflect domestic investment only; this

Chart 1
Research and Development Spending by All Businesses
(Billions of dollars)

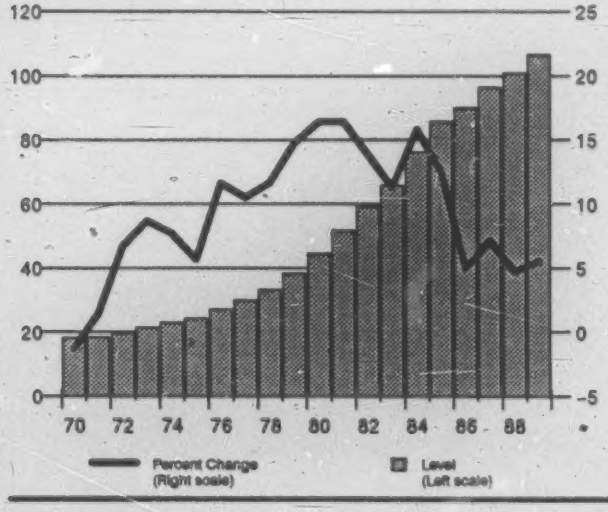

Chart 2
Real Research and Development Spending by All Businesses
(Billions of 1982 dollars)

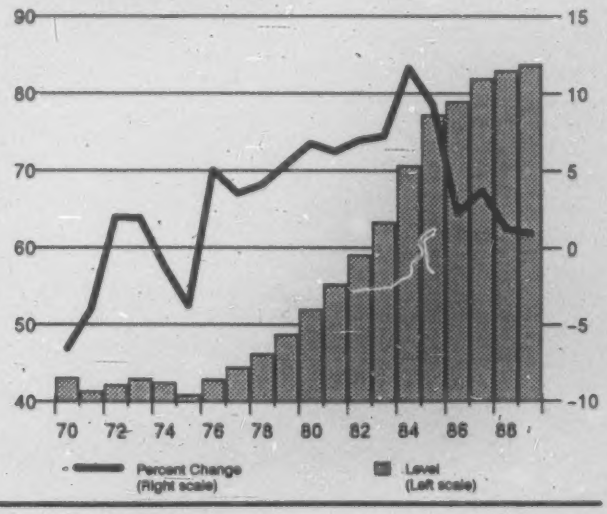

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Table 1
Research and Development Expenditures
(Millions of dollars)

Industry	1987 Actual	1988 Estimated	Planned 1989	Planned 1991	Percent Change 1988–89	Percent Change 1989–91
Iron & Steel	559	620	652	718	5.0	10.1
Nonferrous Metals	452	411	395	412	-3.9	4.3
Electrical Equipment	16,920	16,804	17,328	18,232	3.1	5.2
Machinery	12,965	14,384	15,625	16,567	8.6	6.0
Motor Vehicles	9,521	10,608	11,387	12,127	7.3	6.5
Aerospace	23,506	24,927	26,444	26,805	6.1	1.4
Fabricated Metal Products	1,120	1,147	1,257	1,360	9.6	9.8
Instruments	5,456	4,365	4,528	4,789	3.7	5.8
Stone, Clay & Glass	1,024	1,045	1,202	1,227	15.0	2.1
Lumber & Furniture	140	141	137	149	-2.9	8.7
Chemicals	9,831	10,672	11,274	12,193	5.6	8.1
Paper	613	676	721	796	6.6	10.5
Rubber	1,127	1,331	1,512	1,601	13.5	5.9
Petroleum	1,899	1,968	2,036	2,060	3.4	1.2
Food	1,402	1,523	1,609	1,720	5.6	6.9
Textiles & Apparel	228	284	285	287	0.5	0.5
Other Manufacturing	799	815	887	962	8.7	8.5
ALL MANUFACTURING	87,562	91,724	97,278	102,026	6.1	4.9
ALL NONMANUFACTURING	8,743	9,126	9,129	9,773	0.0	7.1
ALL BUSINESS	96,305	100,850	106,408	111,799	5.5	5.1

report includes noncontract federal funds spent by private business. All data prior to 1988 has been benchmarked to National Science Foundation (NSF) results.

THINGS COULD BE BETTER

The latest survey results confirm that U.S. businesses intend to continue to neglect R&D activity. After averaging 12.7% annual growth in 1975–85, nominal investment rose a slim 5.0% in 1986 and 7.1% in 1987; the estimate for 1988 is only 4.7%.

In constant-dollar terms, the slowdown has been even sharper. Following average annual gains of 6.6% from 1976 to 1985, real investment growth slowed to 2.2% in 1986 and 3.7% in 1987, dwindling to just 1.3% in 1988. While growth of real R&D spending should still outpace inflation (albeit barely) in 1989, the outlook for 1990–91 is for actual declines.

Chart 3
Growth in Real Research and Development Spending and Real Gross National Product

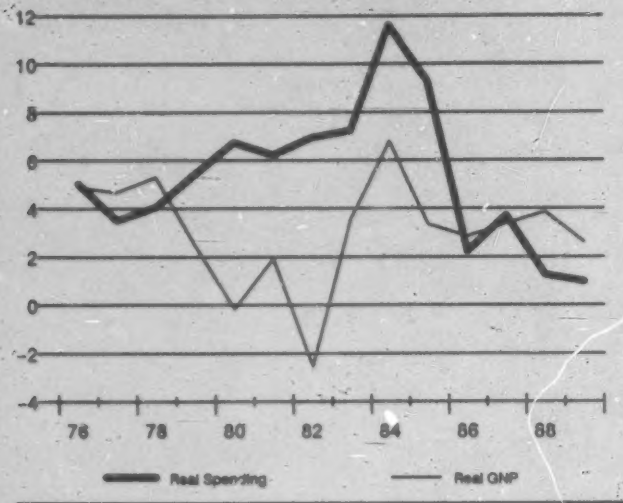
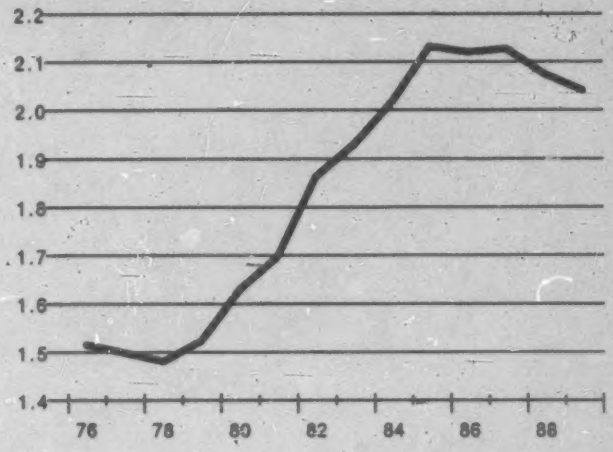


Chart 4
Research and Development Spending as a Percent of GNP



As a share of gross national product, R&D spending rose from 1.5% in 1978 to a peak of 2.1% in 1985, and has since edged down slightly. If respondents' projections of R&D spending and DRI's forecast of GNP growth prove true, the share should fall below 1.9% by 1991.

The 34% depreciation of the dollar since early 1985 has afforded U.S. companies a competitive edge over foreign producers. Real exports thus increased 13% in 1987 and 18% in 1988 as firms took full advantage of this opportunity to increase market share. U.S. firms cannot, however, hope to regain markets by this practice alone since many of the nation's competitors—Korea, Taiwan, and Hong Kong—have currencies tied to the dollar. Moreover, the dollar's strength this year has eroded some of the price advantage U.S. producers have enjoyed.

While there seems to be no easy explanation for the ongoing slump in R&D spending, U.S. firms appear more concerned about short-term profitability rather than long-term opportunities. In light of the rash of mergers, restructurings, and takeovers, businesses have grown more cautious in their spending commitments; persistently high real interest rates have also encouraged strategies geared to short-term goals. The slowdown in profit growth expected over the next few years will only exacerbate this reluctance to fund R&D projects. Moreover, policymakers have already reduced the R&D tax credit from 25% to

20% and threaten to eliminate it at the end of every year. (Some form of the credit, however, is likely to survive.)

A COUPLE OF POSITIVE NOTES

Manufacturers' research and development budgets appear healthier when compared with sales measures (Table 2). After hovering near 2.8–2.9% of sales during the 1960s, investment fell sharply after the mid–1970s, hitting a record low share of 2.1% in 1977–79. By 1983, however, the R&D investment share had reached a new peak of 3.0% and then climbed to 3.7% in 1987. This share is estimated to have slipped to 3.5% last year and is projected to deteriorate further to 3.4% in 1989—still high by historical standards, but showing a disturbing downward trend.

The pattern is similar when R&D investment is measured as a percentage of total capital spending (Table 3). (R&D spending is not, however, a subset of capital investment.) After exceeding 20% in 1983 (for the first time since 1969), the R&D spending share hit 24.7% in 1987 before softening to 23.5% last year. While the latest survey points to further erosion, to 22.3% this year, this is largely the result of the continuing strength of overall capital spending. Indeed, the R&D share looks particularly strong in 1986–87 because total capital outlays were relatively weak.

Chart 5
Research and Development Spending by All Manufacturing Industries as a Percent of Sales

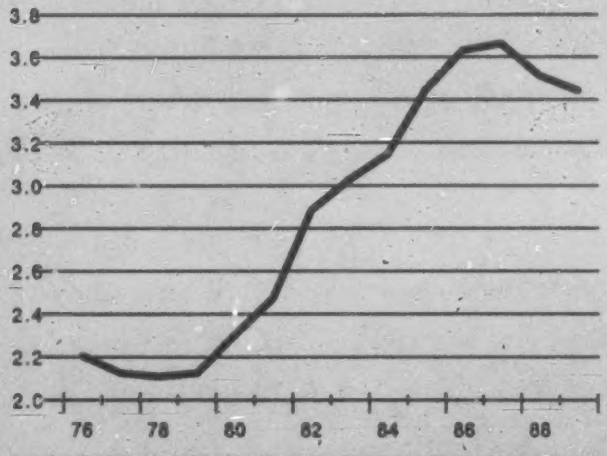


Chart 6
Research and Development Spending by All Businesses as a Percent of Capital Spending

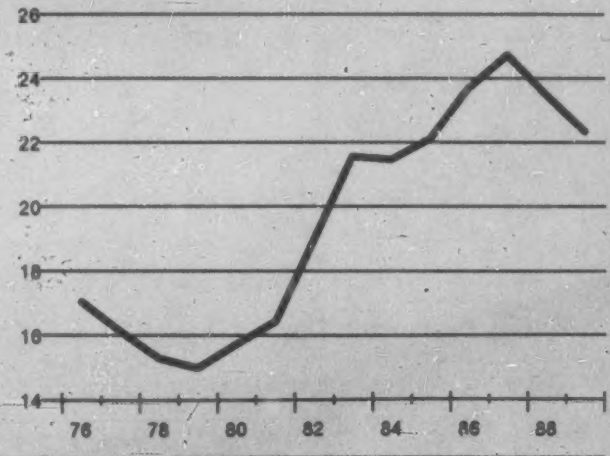


Table 2
Research and Development as a Percent of Sales

Industry	1988	1989
Iron & Steel	1.0	1.1
Nonferrous Metals	0.6	0.5
Electrical Equipment	7.4	7.2
Machinery	5.8	5.9
Autos, Trucks & Parts	4.8	NA
Aerospace	23.2	19.6
Fabricated Metal Products	0.8	0.8
Instruments	6.0	5.6
Stone, Clay & Glass	1.6	1.8
Chemicals	4.4	4.3
Paper	0.5	0.5
Rubber	1.5	1.5
Petroleum	1.6	1.6
Food	0.4	0.4
Textiles	0.5	0.5
Other Manufacturing	0.2	NA
ALL MANUFACTURING	3.5	3.4

Table 3
Research and Development as a Percent of Capital Spending

Industry	1988	1989
Iron & Steel	10.1	10.5
Nonferrous Metals	14.8	12.4
Electrical Equipment	91.9	85.7
Machinery	94.5	103.0
Autos, Trucks & Parts	100.0	73.0
Aerospace	725.7	632.3
Fabricated Metal Products	26.6	26.1
Instruments	100.7	108.1
Stone, Clay & Glass	29.1	27.9
Chemicals	55.4	48.2
Paper	6.0	4.5
Rubber	34.5	36.0
Petroleum	9.9	10.7
Food	11.9	10.4
Textiles	13.4	12.5
Other Manufacturing	3.4	3.0
ALL MANUFACTURING	55.4	50.7
ALL NONMANUFACTURING	3.5	3.2
ALL BUSINESS	23.5	22.3

IMPLICATIONS OF LOWER R&D SPENDING

The reason for concern about the apparent slowdown in research and development spending lies in its impact on potential output and future competitiveness. Because R&D investment yields benefits only with lags, cutbacks in spending today have little immediate effect on potential output and can actually improve profitability in the short term.

The damage comes later. Many studies find that business R&D spending earns net excess social returns of 15–30% on the margin. This means that the average incremental dollar spent on R&D not only pays back the initial investment with interest, but also yields additional returns over the investment's life of 15–30% annually. In the DRI Model of the U.S. Economy, which assumes a net excess social return of 25%, a

permanent 1% reduction in the growth rate of real R&D spending leads to 0.085 percentage point cut in the potential growth rate of real GNP.

The private return to R&D is much lower than the social return because of the "public good" nature of such expenditures; many of the benefits "spill over" from those undertaking the R&D spending to the rest of the economy. For example, competitors can copy new products or processes, passing much of the reward on to consumers or other businesses. For this reason, the federal government has in the past recognized the social value of R&D through subsidies (particularly to basic research), grants, patent protection, and tax credits.

The excess social returns to research and development mean that while firms may be cutting back their R&D spending plans to bolster the private returns to investment, they are shortchanging the net benefit to the economy.

R&D SPENDING BY SECTOR

The aerospace industry continues to lead in research and development outlays, aided greatly by heavy funding from the Pentagon. Tighter national defense budgets, however, will dampen the industry's R&D efforts. After falling 4.9% in 1986, research and development spending in the aerospace industry rebounded 16.5% in 1987 and an estimated 6.0% last year. Survey respondents expect a 6.1% increase in R&D outlays in 1989, but nearly flat growth in 1990–91.

The electrical equipment industry, another major R&D player, is coming off a tough few years: R&D spending declined slightly in 1988, following three years of only marginal growth. Industry respondents report something of a comeback in 1989, with R&D spending up 3.1% and all product groups contributing to the rise (Table 4). Manufacturers of electronic components boosted spending some 37% in 1988, but will follow up with only a 6.1% increase this year. Electrical industrial apparatus makers plan a 5.8% expansion in R&D budgets in 1989, while manufacturers of electric lighting and wiring equipment foresee a 5.0% increase.

After an 11% advance last year, non-electrical machinery makers intend to boost R&D spending another 8.6% this year; all product groups except farm equipment makers will participate in this growth.

Computer companies plan an 8.7% increase in 1989, on top of an 11% rise in 1988. Likewise, manufacturers of general industrial machinery reported a 23.2% R&D budget jump last year and a rise of 16.7% this year. Meanwhile, makers of construction, mining, and materials handling equipment will follow their 1988 R&D budget increase of 9.6% with a 6.6% gain.

Elsewhere within manufacturing, the chemical industry reported an 8.6% R&D increase last year and projects a 5.6% rise for this year. The automotive industry expanded their 1988 research and development budgets more than 11% and foresee a 7.3% increase in the current year's budget. Petroleum industry respondents plan a modest 3.4% increase in their 1989 spending levels, while the food industry looks for a 5.6% hike.

Table 4
Detailed Industry Data

	Research & Development Percent Change		
	1987–88	1988–89	1989–91
Durables			
Blast Furnaces, Steel Works	11.0	5.0	10.1
Nonferrous Metals	-9.0	-3.9	4.3
Primary Nonferrous Metals	-9.1	-4.0	4.0
Nonferrous Rolling and Drawing	3.5	9.8	9.3
Electrical Machinery	-0.7	3.1	5.2
Electric Distributing Equipment	-12.4	4.1	1.4
Electrical Industrial Apparatus	0.1	5.8	6.9
Household Appliances	-7.3	0.5	0.2
Electric Lighting and Wiring	3.2	5.0	15.0
Communication Equipment	-0.8	3.3	4.4
Electronic Components	37.5	[illegible]	4.3
Misc. Electrical	-26.6	10.0	20.0
Nonelectrical Machinery	10.9	8.6	6.0
Farm Equipment	-40.5	-6.7	5.6
Construction, Mining, Materials Handling Eq.	9.6	6.6	7.5
Metalworking Machinery	9.3	4.3	2.3
Special Industry Machinery	-15.9	5.0	5.0
General Industrial Machinery	23.2	16.7	8.4
Office, Computing Machinery	11.0	8.7	6.0
Refrigeration and Service Industry Machinery	-5.7	5.6	10.1
Motor Vehicles	11.4	7.3	6.5
Aircraft	18.8	-5.2	1.4
Fabricated Metals	2.4	9.6	9.8
Cutlery, Hand Tools, Hardware	7.1	10.0	9.8
Plumbing and Heating Eq	25.0	30.0	100.0
Fabricated Structural Metal	0.5	9.9	9.9
Screw Machine Products	6.4	6.0	6.0
Metal Forgings and Stampings	10.0	5.0	6.0
Misc. Fabricated Metals	18.2	9.8	10.1
Instruments	-20.0	3.7	5.8

Table 4
(Continued)

	Research & Development Percent Change		
	1987-88	1988-89	1989-91
Measuring and Controlling Devices	7.2	3.1	6.4
Medical Instruments and Supplies	-81.3	-1.5	5.7
Stone, Clay & Glass	2.1	15.0	2.1
Flat Glass	-3.6	-1.0	3.0
Products of Purchased Glass	-3.8	16.0	2.0
Cement, Hydraulic	5.9	5.0	5.0
Pottery	100.0	25.0	25.0
Concrete, Gypsum, Plaster	0.4	NA	NA
Misc. Nonmetallic Mineral Products	11.1	14.0	NA
Other Durables	1.8	8.3	10.2
Furniture	0.6	-2.9	8.7
Railroad Equipment	275.0	20.0	25.0
Nondurables			
Chemicals	8.6	5.6	8.1
Drugs	15.4	12.2	11.7
Soap, Cleaners, & Toilet Goods	-4.7	4.7	2.7
Paints	3.8	-1.0	1.0
Misc. Chemicals	3.6	3.6	1.0
Paper	10.4	6.6	10.5
Paper Mills	17.7	4.3	6.1
Converted Paper Prod.	1.1	10.4	19.5
Paperboard Containers	-24.7	11.0	5.0
Rubber & Plastic	18.1	13.5	5.9
Miscellaneous Plastics Products	22.3	32.0	30.0
Petroleum	3.6	3.4	1.2
Food Including Beverages	8.7	5.6	6.9
Meat Products	16.9	1.1	2.0
Preserved Fruits and Vegetables	1.4	9.0	11.0
Grain Mill Products	-1.5	13.1	15.0
Sugar Products	33.3	7.0	7.0
Beverages	12.8	5.0	4.0

Table 4
(Continued)

	Research & Development Percent Change		
	1987-88	1988-89	1989-91
Textiles	24.4	0.5	0.5
Weaving Mills, Cotton	25.0	0.0	0.0
Other Nondurables	1.7	8.6	8.3
Tobacco	-16.2	10.0	10.0
Apparel	-25.0	0.0	10.0
Printing and Publishing	27.3	6.0	5.0
Nonmanufacturing			
Mining	-12.4	-7.0	8.0
Metal Mining	26.8	15.6	25.0
Bituminous Coal	4.7	-7.2	6.9
Oil & Gas Extraction	-30.6	-50.0	25.0
Stone & Earth Minerals	100.0	10.0	10.0
Other Transportation	-44.6	5.0	5.0
Trucking and Warehousing	-44.6	5.0	5.0
Electric Utilities	-6.0	-5.1	6.2
Gas & Other Utilities	9.2	17.4	5.0
Communication	5.3	0.0	7.0
Telephone Communications	5.3	0.0	7.0
Trade & Services	18.5	10.5	10.5
General Building Contractors	4.3	-3.5	5.2
Retail and Whole. Trade	2.0	7.0	4.0
Personal & Business Services	27.6	13.8	13.6
Business Services	27.7	14.9	14.8
Computer and Data Processing Services	26.9	15.0	15.0
Miscellaneous Business Services	57.4	12.7	7.6
Amusement & Recreations Services	1.8	2.1	2.0
Health Services	12.2	13.5	9.6

Table 5
Historical Research & Development Expenditures
(Millions of dollars)

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961
Iron & Steel	42	44	46	55	64	80	84	102	98
Nonferrous Metals	20	25	28	35	44	51	68	75	79
Machinery	330	358	455	543	669	781	930	949	901
Electrical Equipment	817	904	983	1,516	1,804	1,969	2,329	2,532	2,483
Aerospace	829	993	1,285	2,138	2,574	2,609	3,090	3,514	3,829
Autos, Trucks & Parts	495	531	561	688	707	856	866	884	936
Fabricated Metal Products	52	55	65	116	135	162	138	145	136
Instruments	178	195	176	200	249	294	309	329	297
Stone, Clay & Glass	40	45	46	60	69	75	81	88	88
Lumber & Furniture	10	10	10	10	14	12	12	10	10
Chemicals	374	407	445	641	705	792	891	980	1,101
Paper	29	33	32	36	35	42	49	56	59
Rubber	54	65	79	105	107	89	115	121	138
Petroleum	149	167	172	182	211	246	278	296	299
Textiles	10	12	12	12	15	26	30	38	30
Food	54	61	70	64	74	83	91	104	125
Other Manufacturing	53	58	64	74	93	105	118	119	105
ALL MANUFACTURING	3,536	3,969	4,529	6,475	7,569	8,272	9,479	10,342	10,714
ALL NONMANUFACTURING	94	101	111	130	162	117	139	168	194
ALL BUSINESS	3,630	4,070	4,640	6,605	7,731	8,389	9,618	10,510	10,908

Industry	1962	1963	1964	1965	1966	1967	1968	1969
Iron & Steel	97	106	116	128	139	135	135	136
Nonferrous Metals	74	77	79	85	93	107	115	121
Machinery	914	958	1,015	1,065	1,217	1,326	1,483	1,546
Electrical Equipment	2,639	2,866	2,972	3,200	3,626	3,867	4,083	4,347
Aerospace	4,042	4,712	5,078	5,148	5,526	5,669	5,765	5,878
Autos, Trucks & Parts	999	1,090	1,182	1,230	1,344	1,354	1,499	1,568
Fabricated Metal Products	146	153	148	145	154	163	183	182
Instruments	309	284	331	403	468	542	663	742
Stone, Clay & Glass	96	100	109	112	117	136	142	159
Lumber & Furniture	10	11	12	11	12	12	20	18
Chemicals	1,175	1,239	1,284	1,356	1,407	1,507	1,589	1,660
Paper	65	69	77	94	117	128	144	188
Rubber	141	156	158	162	168	182	223	261
Petroleum	310	317	393	397	371	371	437	467
Textiles	28	30	32	38	51	57	58	60
Food	121	130	144	157	164	183	184	199
Other Manufacturing	65	54	65	71	77	90	101	121
ALL MANUFACTURING	11,231	12,352	13,195	13,802	15,051	15,829	16,824	17,653
ALL NONMANUFACTURING	234	276	319	384	497	559	603	655
ALL BUSINESS	11,465	12,628	13,514	14,186	15,548	16,388	17,427	18,308

Table 5
(Continued)

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978
Iron & Steel	149	144	147	163	181	215	256	284	314
Nonferrous Metals	126	128	130	145	177	228	250	254	246
Machinery	1,729	1,860	2,158	2,549	2,985	3,196	3,487	3,880	4,283
Electrical Equipment	4,220	4,389	4,680	4,902	5,011	5,105	5,636	5,886	6,507
Aerospace	5,219	4,881	4,950	5,052	5,278	5,713	6,339	7,033	7,536
Autos, Trucks & Parts	1,591	1,768	2,010	2,477	2,476	2,430	2,872	3,478	4,010
Fabricated Metal Products	207	242	253	291	313	324	358	386	384
Instruments	744	746	838	961	1,075	1,173	1,331	1,572	1,998
Stone, Clay & Glass	167	164	183	199	217	233	263	287	324
Lumber & Furniture	52	53	64	71	84	88	107	123	126
Chemicals	1,773	1,832	1,932	2,116	2,450	2,727	3,017	3,202	3,580
Paper	178	187	189	194	237	249	313	333	387
Rubber	276	289	377	426	469	467	502	491	493
Petroleum	515	505	468	498	622	693	767	918	1,060
Textiles	58	59	61	64	69	70	82	83	89
Food	230	240	259	269	298	335	355	415	472
Other Manufacturing	128	131	146	158	177	205	217	250	280
ALL MANUFACTURING	17,362	17,618	18,845	20,535	22,119	23,451	26,152	28,875	32,089
ALL NONMANUFACTURING	705	704	707	715	768	735	845	958	1,229
ALL BUSINESS	18,067	18,322	19,552	21,250	22,887	24,186	26,997	29,833	33,318

Industry	1979	1980	1981	1982	1983	1984	1985	1986	1987
Iron & Steel	375	443	569	679	776	706	676	711	559
Nonferrous Metals	259	285	303	313	322	329	394	423	452
Machinery	4,825	5,901	6,818	8,065	8,861	10,511	12,083	12,322	12,965
Electrical Equipment	7,824	9,175	10,329	11,218	13,054	14,377	15,236	15,712	16,920
Aerospace	8,041	9,198	11,968	14,272	15,089	18,206	21,229	20,180	23,506
Autos, Trucks & Parts	4,668	4,955	4,806	4,797	5,318	6,057	6,984	9,950	9,521
Fabricated Metal Products	455	550	624	638	764	1,023	1,017	1,116	1,120
Instruments	2,505	3,029	3,614	3,946	4,290	4,648	5,097	5,206	5,456
Stone, Clay & Glass	356	406	460	556	680	798	864	951	1,024
Lumber & Furniture	139	148	161	164	174	189	182	188	140
Chemicals	4,038	4,636	5,625	6,604	7,185	7,927	8,540	8,837	9,831
Paper	445	495	566	566	552	594	576	538	613
Rubber	577	656	796	927	1,108	1,186	1,136	1,247	1,127
Petroleum	1,262	1,552	1,972	2,185	2,317	2,364	2,304	2,068	1,899
Textiles	101	115	116	136	150	182	218	246	228
Food	528	620	836	817	881	1,234	1,315	1,535	1,402
Other Manufacturing	286	526	541	626	752	631	672	796	799
ALL MANUFACTURING	36,686	42,690	49,904	56,509	62,273	70,962	78,523	82,026	87,562
ALL NONMANUFACTURING	1,540	1,815	1,906	2,501	3,421	5,125	7,087	7,870	8,743
ALL BUSINESS	38,226	44,505	51,810	59,010	65,694	76,087	85,610	89,896	96,305

Table 6
Historical Research & Development Expenditures as a Percent of Capital Investment

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961
Iron & Steel	4.5	7.4	8.9	5.4	4.7	8.0	10.3	7.6	11.4
Nonferrous Metals	4.7	9.7	12.4	8.0	5.0	10.7	19.7	23.8	26.8
Machinery	42.0	51.9	56.2	50.4	52.1	84.4	91.4	78.4	80.8
Electrical Equipment	152.7	178.1	190.0	207.0	242.1	342.4	328.0	248.2	237.0
Aerospace	552.7	689.0	564.8	574.0	556.5	931.8	1,021.5	1,018.6	1,255.4
Autos, Trucks & Parts	37.6	30.6	38.0	33.0	48.0	79.4	69.1	59.9	68.1
Fabricated Metal Products	11.7	12.1	12.6	18.2	19.6	30.7	22.1	24.1	25.9
Instruments	NA	NA	NA	NA	NA	256.5	213.1	202.6	166.2
Stone, Clay & Glass	9.9	10.2	7.2	6.6	8.9	13.7	11.5	11.2	12.6
Chemicals	26.6	36.5	44.3	44.3	41.0	60.1	76.0	61.7	68.7
Paper	7.1	7.3	6.2	4.5	4.3	7.3	7.6	7.3	9.5
Rubber	22.3	32.1	33.3	32.1	32.2	40.0	41.4	35.1	38.3
Petroleum	5.2	5.7	5.6	5.3	5.5	9.0	10.0	10.2	10.1
Textiles	3.1	4.4	4.0	3.2	4.8	12.0	10.0	9.4	8.5
Food	5.3	6.0	7.2	5.6	6.1	7.5	7.5	7.7	8.3
ALL MANUFACTURING	28.4	33.1	36.2	39.6	43.2	63.7	68.9	63.2	69.0
ALL NONMANUFACTURING	0.5	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.8
ALL BUSINESS	12.1	14.1	15.0	17.4	19.1	24.8	26.8	26.6	28.5

Industry	1962	1963	1964	1965	1966	1967	1968	1969
Iron & Steel	12.7	12.0	8.1	8.1	8.1	7.1	6.7	7.5
Nonferrous Metals	21.8	16.6	14.2	11.9	9.3	9.7	10.4	11.4
Machinery	72.3	77.1	63.1	47.5	41.9	43.8	51.0	42.6
Electrical Equipment	265.9	281.0	252.9	189.3	144.3	123.5	129.0	133.0
Aerospace	1,023.3	1,077.0	1,231.0	975.9	472.3	453.5	470.6	454.8
Autos, Trucks & Parts	68.8	59.9	47.6	41.0	42.9	47.5	56.2	52.4
Fabricated Metal Products	24.6	22.3	17.5	16.8	13.5	12.6	13.5	13.6
Instruments	174.0	148.0	172.3	173.6	152.4	138.2	166.9	191.1
Stone, Clay & Glass	13.2	14.2	13.4	13.0	10.4	14.7	15.9	14.3
Chemicals	74.2	71.8	61.1	48.1	42.0	48.9	56.6	55.1
Paper	10.5	9.8	8.5	8.8	8.8	8.6	11.3	11.6
Rubber	37.6	40.3	33.8	27.7	25.8	27.4	23.4	24.3
Petroleum	10.1	10.2	11.2	10.2	8.3	7.7	8.8	8.9
Textiles	7.1	6.9	5.4	4.8	5.3	7.4	8.9	7.0
Food	8.3	8.7	8.2	8.4	7.8	8.9	8.3	7.2
ALL MANUFACTURING	70.1	71.5	62.2	54.3	48.0	49.1	52.0	48.7
ALL NONMANUFACTURING	0.9	1.0	1.1	1.1	1.3	1.4	1.4	1.3
ALL BUSINESS	28.1	28.9	26.4	23.8	22.1	22.5	22.8	21.4

Table 6
(Continued)

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978
Iron & Steel	9.2	11.4	13.7	13.0	9.2	7.0	8.2	9.9	12.1
Nonferrous Metals	10.7	12.6	13.4	11.9	10.0	13.3	17.7	19.6	16.9
Machinery	45.7	59.0	66.8	64.5	58.2	65.8	64.3	61.1	57.7
Electrical Equipment	120.9	144.7	165.5	140.7	131.8	165.6	156.2	127.5	110.5
Aerospace	593.1	777.8	722.6	633.5	435.3	480.1	621.5	616.9	427.0
Autos, Trucks & Parts	52.2	73.1	66.9	64.7	57.6	72.9	79.7	59.8	55.8
Fabricated Metal Products	17.0	20.1	17.7	16.1	16.2	16.6	16.3	15.7	13.1
Instruments	170.8	190.0	174.6	149.8	130.8	147.7	170.1	167.4	181.7
Stone, Clay & Glass	15.8	17.5	13.7	12.6	13.1	14.0	13.8	12.5	10.3
Chemicals	52.5	56.0	57.2	50.8	39.6	38.3	40.9	43.5	46.1
Paper	10.3	14.6	13.0	9.7	8.2	8.5	10.5	9.6	10.2
Rubber	30.1	36.5	36.6	27.3	29.1	38.9	35.6	27.8	21.2
Petroleum	10.0	9.7	9.8	10.8	8.8	7.6	7.7	7.8	8.1
Textiles	7.3	6.6	5.7	6.3	6.5	8.2	8.4	7.0	6.8
Food	6.9	7.2	7.9	7.2	7.0	7.6	6.6	7.3	7.2
ALL MANUFACTURING	46.9	52.4	53.2	48.5	42.1	43.7	44.7	42.8	40.8
ALL NONMANUFACTURING	1.3	1.2	1.0	0.9	0.9	0.8	0.8	0.8	0.9
ALL BUSINESS	19.7	19.7	18.9	17.7	16.4	17.0	17.0	16.1	15.3

Industry	1979	1980	1981	1982	1983	1984	1985	1986	1987
Iron & Steel	11.7	12.9	16.4	18.0	23.9	19.9	16.4	21.4	11.9
Nonferrous Metals	15.7	13.4	12.0	16.5	18.6	15.4	21.0	21.9	20.9
Machinery	47.5	51.7	49.8	60.0	65.6	68.2	75.6	90.5	93.6
Electrical Equipment	103.7	93.9	97.7	101.9	114.3	98.4	98.5	110.9	110.7
Aerospace	297.8	257.8	356.2	418.5	518.1	509.3	614.9	531.1	663.1
Autos, Trucks & Parts	56.0	54.9	48.9	61.7	73.0	54.1	47.7	71.3	79.9
Fabricated Metal Products	14.1	16.5	17.2	20.7	27.2	29.8	28.5	27.9	27.9
Instruments	176.5	181.1	178.5	187.6	237.8	202.3	197.5	228.6	144.6
Stone, Clay & Glass	8.9	10.2	13.5	19.2	24.5	25.8	25.4	30.3	30.4
Chemicals	41.2	39.9	42.9	52.2	55.5	51.7	51.9	52.6	59.9
Paper	8.5	7.6	9.3	10.1	9.3	8.2	6.7	6.1	6.8
Rubber	23.4	32.3	36.9	42.8	45.0	38.2	29.4	32.1	32.0
Petroleum	8.3	7.9	7.6	8.3	10.0	9.3	8.6	11.5	11.1
Textiles	7.1	7.5	7.0	9.3	9.7	9.5	12.3	14.8	11.7
Food	7.3	7.6	6.7	9.3	11.3	14.0	12.7	14.5	12.7
ALL MANUFACTURING	38.2	38.0	39.4	46.8	53.6	51.1	51.2	57.5	60.0
ALL NONMANUFACTURING	1.0	1.1	1.0	1.3	1.8	2.4	3.0	3.3	3.6
ALL BUSINESS	15.0	15.7	16.4	19.0	21.6	21.5	22.1	23.7	24.7

Table 7
Historical Research & Development Expenditures as a Percent of Sales

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961
Iron & Steel	NA	NA	NA	NA	NA	0.5	0.5	0.6	0.6
Nonferrous Metals	NA	NA	NA	NA	NA	0.6	0.7	0.7	0.7
Machinery	NA	NA	NA	NA	NA	3.3	3.5	3.5	3.4
Electrical Equipment	NA	NA	NA	NA	NA	10.4	10.5	10.8	9.9
Aerospace	NA	NA	NA	NA	NA	16.9	19.5	23.6	24.5
Autos, Trucks & Parts	NA	NA	NA	NA	NA	4.2	3.3	3.0	3.7
Fabricated Metal Products	NA	NA	NA	NA	NA	0.8	0.6	0.6	0.6
Instruments	NA	NA	NA	NA	NA	5.1	4.7	4.8	4.4
Stone, Clay & Glass	NA	NA	NA	NA	NA	0.8	0.7	0.8	0.8
Chemicals	NA	NA	NA	NA	NA	3.5	3.4	3.8	4.1
Paper	NA	NA	NA	NA	NA	0.3	0.3	0.4	0.4
Rubber	NA	NA	NA	NA	NA	1.3	1.4	1.5	1.7
Petroleum	NA	NA	NA	NA	NA	1.6	1.7	1.8	1.8
Textiles	NA	NA	NA	NA	NA	0.2	0.2	0.3	0.2
Food	NA	NA	NA	NA	NA	0.1	0.1	0.2	0.2
ALL MANUFACTURING	NA	NA	NA	NA	NA	2.5	2.6	2.8	2.9

Industry	1962	1963	1964	1965	1966	1967	1968	1969
Iron & Steel	0.5	0.6	0.5	0.5	0.6	0.6	0.5	0.5
Nonferrous Metals	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.5
Machinery	3.1	3.1	2.9	2.7	2.6	2.7	2.9	2.8
Electrical Equipment	9.4	9.8	9.9	9.3	9.1	9.2	9.0	9.1
Aerospace	24.9	27.9	30.3	29.4	26.0	22.1	20.8	21.9
Autos, Trucks & Parts	3.1	3.1	3.2	2.7	3.0	3.3	3.0	3.1
Fabricated Metal Products	0.6	0.6	0.5	0.4	0.4	0.4	0.4	0.4
Instruments	4.5	4.1	4.5	4.7	4.7	4.9	5.4	5.7
Stone, Clay & Glass	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9
Chemicals	4.1	4.0	3.8	3.7	3.5	3.6	3.5	3.5
Paper	0.4	0.4	0.4	0.5	0.6	0.6	0.6	0.8
Rubber	1.6	1.6	1.5	1.4	1.3	1.4	1.5	1.6
Petroleum	1.8	1.8	2.1	2.1	1.8	1.7	1.9	1.9
Textiles	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Food	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ALL MANUFACTURING	2.8	2.9	2.9	2.8	2.8	2.8	2.8	2.7

Table 7
(Continued)

Industry	1970	1971	1972	1973	1974	1975	1976	1977	1978
Iron & Steel	0.6	0.6	0.5	0.4	0.4	0.5	0.5	0.6	0.5
Nonferrous Metals	0.6	0.6	0.5	0.5	0.5	0.8	0.7	0.6	0.5
Machinery	3.1	3.3	3.3	3.3	3.2	3.3	3.3	3.2	3.0
Electrical Equipment	9.0	9.1	8.8	8.0	7.6	8.0	7.6	6.7	6.5
Aerospace	21.3	21.8	23.5	20.2	19.4	19.7	20.8	21.7	20.2
Autos, Trucks & Parts	3.7	3.0	3.2	3.3	3.6	3.5	3.0	3.0	3.0
Fabricated Metal Products	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4
Instruments	5.7	5.5	5.4	5.4	5.1	5.3	5.3	5.4	5.9
Stone, Clay & Glass	1.0	0.9	0.8	0.8	0.8	0.9	0.9	0.9	0.8
Chemicals	3.7	3.6	3.4	3.2	2.9	3.0	2.9	2.7	2.8
Paper	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.7
Rubber	1.7	1.6	1.8	1.7	1.7	1.7	1.6	1.2	1.1
Petroleum	2.1	1.9	1.6	1.4	1.1	1.0	0.9	0.9	1.0
Textiles	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Food	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
ALL MANUFACTURING	2.7	2.6	2.5	2.3	2.2	2.3	2.2	2.1	2.1

Industry	1979	1980	1981	1982	1983	1984	1985	1986	1987
Iron & Steel	0.6	0.7	0.8	1.5	1.7	1.4	1.4	1.6	1.1
Nonferrous Metals	0.5	0.5	0.5	0.6	0.6	0.6	0.8	0.8	0.8
Machinery	2.9	3.3	3.4	4.3	4.9	5.0	5.6	5.9	6.0
Electrical Equipment	6.7	7.1	7.4	7.6	8.2	7.7	7.9	8.0	8.8
Aerospace	16.6	15.8	18.5	21.5	20.2	23.2	23.5	20.0	22.7
Autos, Trucks & Parts	3.6	4.7	4.1	4.3	3.6	3.4	3.7	5.2	4.8
Fabricated Metal Products	0.4	0.5	0.5	0.5	0.6	0.8	0.7	0.8	0.8
Instruments	6.6	6.9	7.5	7.6	8.0	7.8	8.4	8.4	8.2
Stone, Clay & Glass	0.8	0.9	1.0	1.2	1.4	1.5	1.6	1.7	1.6
Chemicals	2.7	2.9	3.1	3.9	3.9	4.0	4.3	4.5	4.6
Paper	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5
Rubber	1.2	1.4	1.5	1.7	1.8	1.7	1.6	1.7	1.4
Petroleum	0.9	0.8	0.9	1.0	1.2	1.2	1.3	1.7	1.5
Textiles	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4
Food	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.4
ALL MANUFACTURING	2.1	2.3	2.5	2.9	3.0	3.1	3.4	3.6	3.7